APPENDIX H: OBPR Science Metrics Presentation

Research Maximization and Prioritization Task Force

Office of Biological and Physical Research Science Productivity Metrics

Background
Current Approach and Status
Future Directions

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Science Productivity Metrics: Background

Metrics for Basic Research: Requirements, Findings and Recommendations

- We have been committed to establishing, growing, and improving a high quality scientific research program
  - "It's the right thing to do."
  - We have had a series of independent reviews by NAS, NAE, IOM, NMAB, etc.: "Measure by Review"
  - OBPR Task and Bibliography
- Government Performance and Results Act, 1993
- *Implementing The Government Performance and Results Act for Research, A Status Report, 2001*
  - National Academy of Science
  - National Academy of Engineering
  - Institute of Medicine

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Government Performance and Results Act, 1993

- Law as interpreted by Office of Management and Budget Circular Requires:
  - NASA Strategic plan (at least every three years)
  - NASA Annual Performance Plans
    - Accompany budget
    - Establish Annual performance goals and targets
    - "outcome" orientation, quantitative, fiscal year specific targets
    - Must align with strategic plan
  - NASA Annual Performance Reports against past year's plan
    - NASA has instituted annual review by NASA Advisory Committee
- NASA has not been satisfied with the different approaches used to date. We are working with the Office of Science and Technology Policy and the Office of Management and Budget to apply NRC guidance to develop an appropriate approach for research programs.

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Science Productivity Metrics: The Problem of Measuring Science Outcomes

Reference: *Implementing The Government Performance and Results Act for Research, A Status Report* NRC, 2001

- "Because the outcomes of most research programs are not clear for several years, especially those requiring launching, the effort to report outcomes can lead to the use of numbers that mean little with respect to the new knowledge hoped for." p. 104
- "The struggle is to quantify 'intangible' results, such as knowledge. Most government programs have a product that is easy to describe, including many NASA missions. But when knowledge is the objective, its form is unknown, and its discovery is often serendipitous. That kind of objective defies the use of conventional metrics." p. 105

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Science Productivity Metrics: Proposed Best Practices

How do we capture information appropriate to assess science quality and productivity?

OBPR Program Tasks and Bibliography, FY2001 now includes fields intended to reflect the impact and utility of the research results:

- Impact on America: This section has been added so that we can better understand the impact that NASA funded microgravity research has on America.
  - Industry Affiliates
  - Innovative Technologies Developed: If this investigation has contributed to the development of any new technological advances, please identify each one and include a short description.
  - Who is using the results of your research?
  - Where have your recent graduate students found employment?
  - Number of times that your work has appeared in the popular press?
  - Number of times that your work has appeared on a magazine cover?
  - If you have a science website, or your work is represented on one, please include the address.

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Science Productivity Metrics: Proposed Best Practices

How do we manage science to help ensure research productivity?

- Peer review of ground-based and flight research via the NASA Research Announcement process
  - Proposals seeking renewal must include a section describing progress in the prior funding period.
  - The peer review panel is required to include as part of their review an assessment on the qualifications of the Principal Investigator, Co-investigators, and institutional capabilities.
- Continued assessment of flight investigations during development
  - Criteria for experiment success are established and reviewed
    - Example: Science Requirements Document - criteria defined for:
      - » Fully Successful
      - » Successful
      - » Minimally Successful
  - The need for access to space to accomplish the scientific objectives continues to be assessed. Has progress been made on the ground that mitigates the need for the flight experiment?

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Current Metrics: FY2001 Bioastronautics Research Division Task Summary

Total Number of Research Tasks	312
Total Number of Principal Investigators	260
Total Number of co-Investigators	357
Total Number of Students Supported	877
Post-Doctorate	206
PhD	167
Graduate	195
Undergraduate	309
Total Number of Bibliographic Listings	929
Articles in Peer-Reviewed Journals	266
Books / Chapters in Books	26
Dissertations and Theses	24
Patents	5
Other (proceedings, non-peer reviewed articles, etc.)	608

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Current Metrics: FY2001 Fundamental Space Biology Division Task Summary

Total Number of Research Tasks	149
Total Number of Principal Investigators	122
Total Number of co-Investigators	105
Total Number of Students Supported	563
Post-Doctorate	146
PhD	111
Graduate	83
Undergraduate	223
Total Number of Bibliographic Listings	576
Articles in Peer-Reviewed Journals	233
Books / Chapters in Books	13
Dissertations and Theses	10
Patents	2
Other (proceedings, non-peer reviewed articles, etc.)	318

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Current Metrics: FY2001 Physical Sciences Division Task Summary

Total Number of Research Tasks	553
Total Number of Principal Investigators	451
Total Number of co-Investigators	719
Total Number of Students Supported	1407
Post-Doctorate	186
PhD	527
Graduate	311
Undergraduate	383
Total Number of Bibliographic Listings	2020
Articles in Peer-Reviewed Journals	669
Books / Chapters in Books	43
Dissertations and Theses	29
Patents	15
Other (proceedings, non-peer reviewed articles, etc.)	1264

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New Metrics Under Consideration by OBPR

Metrics related to or based on Committee on Microgravity Research (CMGR) Analysis of Physical Sciences Division Program

- Quality of Investigators (Is the program capable of attracting a cadre of high quality investigators?)
  - Nobel Laureates
  - Membership in Academies
  - Fellows in Major Scientific Societies
  - Awards
- Quality of Research
  - Publication in respected journals
  - Citation index
  - Download of flight data for use by other scientists
- Impact
  - Documented Industrial Impact
  - Textbooks
  - Patents

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New Metrics Under Consideration by OBPR

Metrics related to or based on ReMAP research prioritization criteria

- Scientific Importance
- Impact on Scientific and Technological Community
- Relevance to a Broad Constituency
- Contributions to National Goals

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New Method for Determining Metrics Based on NRC Study

- Plan for Expert Review (Measurement by Review) p. 105
  - Continue to report GPRA type metrics
  - Review one-third of the research program annually
    - Provides regular scrutiny
  - Review of the degree of integration within research and the connection of the research to applications and technology
  - "Originators of this approach believe that the research community will show far more enthusiasm for evaluating research programs with expert review than for evaluation according to annual measures and results."
- Relieves several major concerns about the past method.
  - When the importance and relevance of a program are defined in terms of metrics, a program considered unmeasurable or difficult to measure could lose priority in the budget process relative to programs that are easier to quantify.
  - Unmeasurable or difficult-to-measure programs give the perception that their progress and ability to produce useful results are not being tracked regularly.

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Microgravity Research Performance Goals

Implementation Plan to Accomplish Program Objectives

Performance Goal 1.25 Use microgravity to establish and improve quantitative and predictive relationships between the structure, processing, and properties of materials.